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A SURVEY OF BODY FAT CONTENT OF U.S. NAVY MALE PERSONNEL

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REPORT NO. 83-4

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Report No. 83-4 was supported in part by the Department of the Navy, Naval Medical Research and Development Command, Bethesda, Maryland, under research Work Unit M0096-PN.001-1044. The views presented in this paper are those of the authors. No endorsement by the Department of the Navy has been given or should be inferred.

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SUMMARY

In response to DOD directive 1308.1, the United States Navy has released a new instruction, OPNAVINST 6110.1B, covering health and physical readiness. This instruction changes the standards for weight control from height/weight tables to a 22% body fat (%BF) standard for men estimated from neck and abdominal circumferences. In order to determine the possible impact of this change, we collected information on a sample of Navy male personnel to determine their compliance with weight control standards based both on height/weight tables and on %BF.

Height, weight, age, neck circumference and abdominal circumference measures were collected on a sample of 986 male U.S. Navy personnel: 174 recruits, 309 recruit training staff, 436 auxiliary vessel crew members, and 67 submarine crew members. Percent body fat was determined using the methods described in 6110.1B. Compliance with height/weight standards was assessed using the table in 6110.1B.

The mean %BF for the total survey sample was 16.8% ($\pm$5.3). Adjusting for differences between age distribution of our sample and that of the total Navy male population, it is estimated that 15.8% ($\pm$1.2) of the Navy male population will exceed the 22% BF standard. For the survey sample, 16.5% of the personnel exceeded the 22% standard while 15.4% exceeded the height/weight standards. This suggests changing to the %BF standard will not greatly effect the total number of personnel on weight control programs.

However different personnel will be identified as overweight depending upon the standard used. In this sample, 35.6% of the personnel who exceeded the height/weight standards do not exceed the 22% fat standard, and 7.8% of those meeting the height/weight standards will exceed 22% fat. The personnel reclassified as exceeding the weight control standard on the basis of %BF will tend to be from the older personnel. The change to % fat standards can be expected to impact more heavily on the Navy's older personnel.

INTRODUCTION

In June of 1981, the Department of Defense (DOD) issued a new directive (No. 1308.1) updating DOD policy governing physical fitness and weight control for the United States armed forces. One of the important policy changes contained in this directive was a change from height/weight tables to a standard based on the percentage of body weight contributed by fat (so called "% body fat") as the basis for implementing weight control policy.

In response to this DOD directive, the U.S. Navy has reviewed and updated its physical fitness and weight control programs and issued a new instruction, OPNAVINST 6110.1B, covering physical fitness and weight control under the broader subject of "Health and Physical Readiness." This new instruction implements the DOD policy of using a % body fat standard. Minimum standards are 22% body fat for all for male personnel and 30% for all female personnel. An individual's percent body fat is to be evaluated annually in conjunction with assessment of other physical readiness standards. Additionally, personnel will be evaluated any time the individual's weight exceeds the height/weight tables, or any time the individual appears to be overweight to his superiors.

In this instruction, percent body fat is to be estimated using equations developed by Wright and his co-workers (Wright, Dotson & Davis, 1980, 1981). In these equations, body fat percentage is estimated from body circumferences. Two circumferences, neck and abdomen, are used for males and and five circumferences, neck, abdomen, biceps, forearm and thigh are used for women. These equations were developed on and for U.S. Marine Corps personnel and have strong correlations with percent body fat determined from body density ($r=0.86$ for men, 4; $r=0.73$ for women; Wright, Dotson & Davis, 1980).

Effective implementation of these new standards requires that the Commander of the Naval Military Personnel Command have available information about the immediate impact of the new standards upon existing personnel. It is the purpose of this report to provide some of this information. This report contains the results of a survey to determine the distribution of percent body fat values for a sample of male Navy personnel using the equation of Wright and co-workers (Wright, Dotson & Davis, 1981). From that survey, we have estimated the body fat content distribution which might be expected for the total U.S. Navy male population.

METHODS

Measurements of neck and abdominal circumference, and height, weight, and age were gathered on a sample of 986 male Navy personnel. Personnel were chosen from four different commands in the San Diego, CA area, two afloat and two ashore. Approximately one-half of the sample was stationed ashore. Specifically, the sample consists of 174 recruits at the

completion of recruit training; 309 recruit training staff personnel; 436 members of an auxiliary vessel crew; and 67 crewmembers of a nuclear attack submarine which had just returned from a deployment.

Circumference measurements were collected in conformance with the descriptions given in OPNAVINST 6110.1B. Height and weight were determined for the survey participants in shorts and socks. Percent body fat was calculated for each participant using the formula from Wright et al. (Wright, Dotson & Davis, 1981):

$$\% \text{ FAT} = [0.740 \times (\text{AB-CIRC.})] - [1.249 \times (\text{NK-CIRC.})] + 0.528$$

WHERE: AB-CIRC = abdominal circumference

NK-CIRC = neck circumference

Additionally, each participant was determined to be overweight or not overweight on the basis of exceeding or not exceeding the upper limit of the height/weight tables given in OPNAVINST 6110.1B.

A computer data file of the collected measures was constructed. Subsequent data analyses were performed using the Statistical Package for the Social Sciences (SPSS) (Nie, Hull, Jenkins, Steinbrenner & Brent, 1975). Distributions of percent fat values were constructed for each command personnel sample as well as for the total study sample. The distribution of percent body fat for the total U.S. Navy male population was estimated by adjusting the percent fat results for the survey sample for differences in age distribution between the survey sample and the total U.S. Navy male population (NAVMILPERSCOM, 1981).

To assess the impact of changing the overweight standards, frequency tables were constructed dividing the survey sample into the fractions exceeding or not exceeding the percent fat standard and exceeding or not exceeding the overweight standard based upon the height/weight tables. To assess the effect of age upon the fraction of personnel failing to meet the standard for weight control, additional frequency tables were constructed to show the fraction of the sample failing to meet each standard by age group. The association between age and percent fat was assessed by simple linear correlation.

RESULTS

A description of the physical characteristics of the Navy sample is given in Table 1. The average body fat content for this sample was 16.8%. The body fat content distribution for the samples from each of the different commands surveyed are given in Figures 1-4. The numbers shown on the % body fat axis represent the upper limits of the % body fat interval

represented by the bar. In each figure, that portion of the distribution representing individuals whose body fat content exceeds the proposed 22% standard is shaded for emphasis.

Figure 5 shows an estimate of the distribution of body fat content for the total U.S. Navy male population. Based on the current sample, we estimate 15.8% (± 1.2%) (Meyer, 1980, p. 190) of the male Navy population will have body fat contents in excess of the proposed 22% fat standard.

Comparing the two weight control standards, Table 2 shows the classification frequency for the individuals in this survey sample as complying with or exceeding the height/weight table standard contained in 6110.1B and as complying with or exceeding the 22% body fat standard. As can be seen, 16.5% of the sample exceed the 22% fat standard, while 15.4% exceed the height/weight standard.

It may be noted, only 9.9% of the sample were classified as exceeding both standards. Five and 4/10ths percent of the sample classified as overweight by the height/weight tables are found to be within the percent fat standards. Similarly, another 6.6% of the sample who were within the height/weight standards are found to exceed 22% body fat. Thus, under each overweight classification system there is a group of individuals whose classification depends upon the particular standard applied. While the overall percentage of the sample classified as overweight does not change markedly between standards, the individuals making up 35-40% of the overweight group does change as the two different standards are applied.

Table 3 presents information similar to that given in Table 2, but broken down by age group. The 3rd through 6th columns in Table 3 correspond to the same information categories shown in the four "inner cells" of Table 2.

The results presented in Table 3 suggest the older age groups will be affected more by the change from height/weight standards to % fat standards than will the younger age groups. For example above age 30 in this sample, the number of individuals considered within the height/weight standards but now classified as having excessive fat (column 5) is approximately twice as great as the number of individuals overweight by the height/weight tables but now found to be within the % fat standards (column 4). For individuals less than 20 years old the opposite result holds. Fewer individuals by one-half are reclassified as excessively fat than are reclassified as within the % fat standards.

A general positive association between age and % fat was found for this sample of personnel, $r = 0.37$ ($p<0.001$). This association is depicted graphically in Figure 6, which shows the distribution of % body fat values for the different age groups. Again, the portion of the distribution made up of individuals with greater than 22% body fat is shaded for emphasis.

Table 1

SURVEY SAMPLE PHYSICAL CHARACTERISTICS*

	N	Age (yrs)	Height (in)	Weight (lbs)	% Body Fat
Recruits	174	19.9 (±2.5)	69.2 (±2.7)	161.5 (±21.8)	14.5 (±4.2)
Recruit Training Staff	309	33.2 (±5.4)	68.7 (±3.0)	172.0 (±26.4)	18.8 (±5.1)
Auxiliary Vessel Crew	436	25.7 (±6.6)	69.0 (±3.0)	166.6 (±25.2)	16.4 (±5.3)
Submarine Crew	67	24.6 (±5.2)	69.9 (±2.3)	179.2 (±24.8)	16.1 (±5.5)
TOTAL	986	26.5 (±7.3)	69.0 (±2.9)	168.2 (±25.3)	16.8 (±5.3)

*values shown are means (± std. dev.)

FIGURE 1.

DISTRIBUTION OF PERCENT BODY FAT VALUES FOR RECRUIT SAMPLE (N = 174)

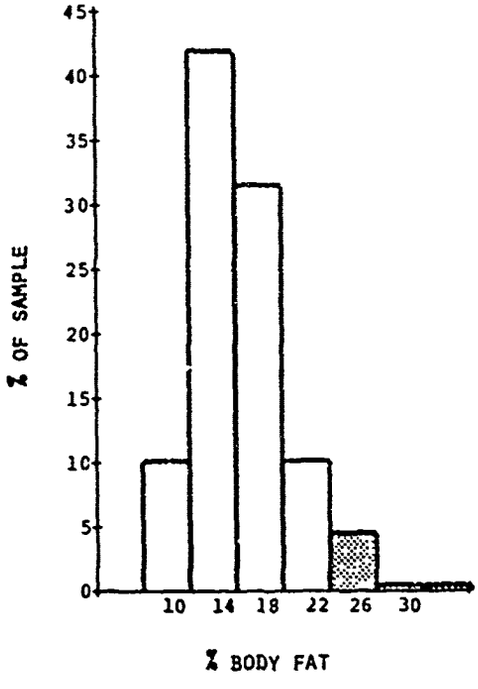

FIGURE 2.

DISTRIBUTION OF PERCENT BODY FAT VALUES FOR RECRUIT TRAINING STAFF SAMPLE (N = 331)

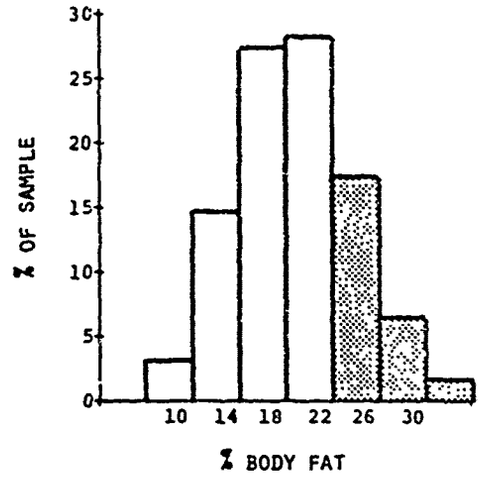

FIGURE 3.
DISTRIBUTION OF PERCENT BODY FAT VALUES
FOR AUXILIARY VESSEL CREW SAMPLE
(N = 436)

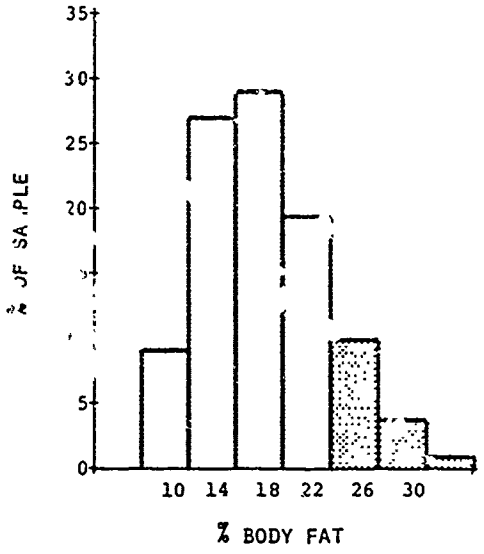

FIGURE 4.
DISTRIBUTION OF PERCENT BODY FAT VALUES
FOR SUBMARINE CREW SAMPLE
(N = 67)

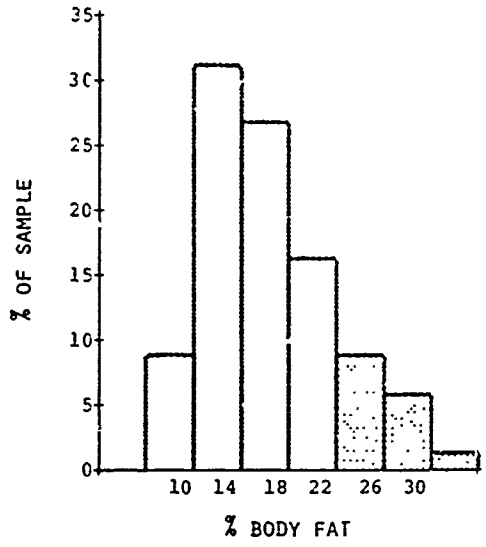

FIGURE 5.
ESTIMATED DISTRIBUTION
OF PERCENT BODY FAT VALUES
FOR U.S. NAVY MALE PERSONNEL

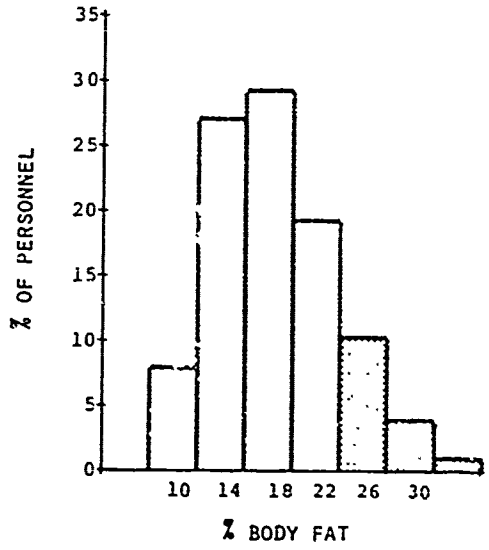

Table 2

DISTRIBUTION OF SAMPLE PERSONNEL BY

NAVY HEIGHT/WEIGHT AND % BODY FAT STANDARDS

(Each cell gives % of sample and number meeting each criterion)

	Less Than or Equal Ht/Wt Std.	Greater Than Ht/Wt Std.	Total
Less Than or Equal 22% Fat	78.0% (N=754)	5.5% (N=53)	83.5% (N=807)
Greater Than 22% Fat	6.6% (N=64)	9.9% (N=96)	16.5% (N=160)
Total	84.6% (N=818)	15.4% (N=149)	100% (N=967)

Table 3

COMPARISON OF OVERWEIGHT STANDARDS BY AGE

Age Group	N	% Age Group < Ht/Wt and ≤ % Fat	% Age Group > Ht/Wt but ≤ % Fat	% Age Group > % Fat but ≤ Ht/Wt	% Age Group > % Fat and > Ht/Wt
< 20 yrs	155	90.3	3.9	1.3	4.5
20 - 24 yrs	297	86.9	3.4	4.0	5.7
25 - 29 yrs	178	75.8	7.9	3.4	12.9
30 - 34 yrs	145	73.8	4.8	8.3	13.1
35 + yrs	176	60.2	7.4	15.9	16.5

BODY FAT CONTENT DISTRIBUTIONS BY AGE GROUP
MALE U. S. NAVY PERSONNEL SAMPLE (N = 986)

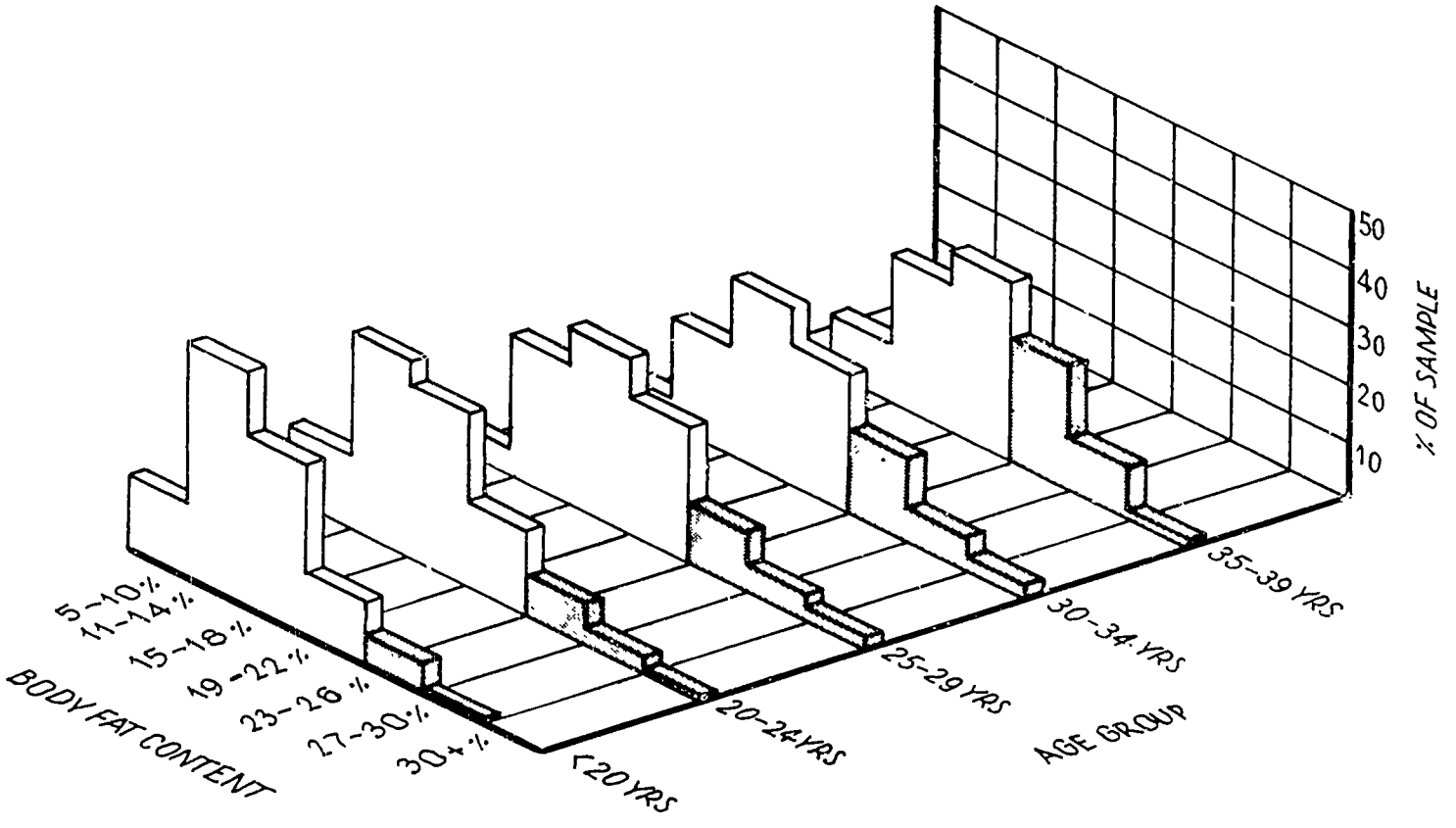

FIGURE 6.

DISCUSSION

While small, and including only four commands, we believe that the personnel sample studied here provides a reasonable basis for making population estimates. The recruit sample represents three complete recruit companies. The recruit training staff sample for the most part represents all the personnel enrolled in company commander training school during a particular period last year. The remainder were volunteers from the active staff at the Recruit Training Center, San Diego. The submarine crew sample represents approximately one-half the total crew. The auxiliary vessel crew sample, while only comprising about one fifth of the total crew, represents a relatively complete sampling within several divisions. Additionally, we estimate from the number of Navy vessels and their individual manning requirements and from the Navy population statistics (Nie, et al., 1975) that nearly one half of the male Navy population is stationed aboard ship as is the case in our sample.

One other survey of body composition has been reported for male Navy personnel. Wright, Dotson, and Bachinski (1980) determined body composition on 100 randomly selected personnel from the Naval Military Personnel Command (NMPC). The average age for these personnel was 34.5 years; the average height, 69.5 inches; and the average weight, 174.3 pounds. Thus, they are comparable to the recruit training staff sample of this study on these variables. The mean percent fat for this NMPC sample calculated from the individual neck and abdomen circumferences is 19.0% ($\pm$5.77), which also compares well with the value of 18.8 measured in our training staff sample. Both samples are primarily composed of senior personnel stationed ashore, and the statistical similarity between these two samples offers partial validation of our sampling procedures.

The results given in Table 2 indicate the change from height/weight tables to a 22% body fat standard will not greatly affect the total number of personnel requiring weight control programs. However, as the results in Table 3 show, it appears that the make-up of the personnel needing weight control will change somewhat. A greater number of older personnel and a smaller number of younger personnel will find themselves in these programs. Our older, senior personnel are responsible for most of the administrative and training functions in the Navy, and hence very valuable to the Navy. It would thus be important to implement the standards and legislate compliance in a fashion which allows those personnel who are willing to comply adequate time to meet the standards, and not be subject to premature, unnecessary administrative action.

While the correlation between age and % body fat is highly significant, it is rather small. Only 13.7% of the variation in body fat among the individuals in this study can be accounted for by variation in age. Thus, factors other than age may be important determiners

of the distribution of % body fat values among this study sample in a more meaningful fashion. For example, studies performed in this and other laboratories have reported correlation coefficients of 0.5 - 0.6 between aerobic capacity and % body fat (Vogel, 1982; Hodgdon, unpublished data). These correlations were found even among groups of individuals of similar ages, and thus do not appear age-dependent. In light of this association between aerobic fitness and percent fat, the provisions of OPNAVINST 6110.1B which promote physical activity among personnel of all ages (rather than just those under 40 as was previously the case) may be particularly helpful in decreasing the relationship between age and the ability to meet the percent fat standards.

While the Navy standard contained in OPNAVINST 6110.1B is 22% body fat for male personnel, the standard recommended by the Department of Defense is 20%. It is the Navy's eventual goal to acheive this more stringent standard (William Jackson, CAPT USN, NMPC-6H, personal communication). To help assess the changes that will be necessary to achieve this 20% standard, we also constructed a frequency table, Table 4, showing the percentages of our sample which met or exceeded a 20% body fat standard. As in Table 2, compliance with the body fat standard is contrasted with compliance with the standards based on the height/weight tables. It can be seen that approximately one quarter of our Navy sample exceeded the 20% standard. Clearly implementation of a 20% body fat standard would have a greater impact and would require changes in the dietary and physical activity habits of a substantial number of male personnel, if we are to maintain our current force level.

Table 4

DISTRIBUTION OF SAMPLE PERSONNEL BY NAVY HEIGHT/WEIGHT STANDARDS AND DOD % BODY FAT RECOMMENDATIONS
(Each cell gives % of sample and number meeting each criterion)

	Less Than or equal Ht/Wt Std.	Greater Than Ht/Wt Std.	Total
Less Than or Equal 20% Fat	71.6% (N=692)	2.8% (N=27)	74.4% (N=719)
Greater Than 20% Fat	13.0% (N=126)	12.6% (N=122)	25.6% (N=248)
Total	84.6% (N=818)	15.4% (N=149)	100% (N=967)

CONCLUSIONS

Our results indicate that about 15.8% of the Navy male population will exceed the newly-imposed percent body fat standard. This percentage does not appear to be markedly different from the percentage of male Navy personnel currently exceeding the height/weight standards. It appears the change in standards will impact more heavily upon the older personnel. More older personnel were found to exceed the % fat standard than exceeded the height/weight standards. Therefore particular attention will have to be paid to programs for these older personnel. Attainment of the eventual goal of 20% body fat as a standard will require effective implementation of programs to modify the current dietary and physical activity patterns of Navy male personnel.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 83-4	2. GOVT ACCESSION NO. AD-A131500	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A Survey of Body Fat Content of U.S. Navy Male Personnel		5. TYPE OF REPORT & PERIOD COVERED Interim 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. A. Hodgdon & E. J. Marcinik		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Health Research Center P.O. Box 85122 San Diego, CA 92138		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS M0096-PN.001-1044
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Medical Research & Development Command National Naval Medical Center Bethesda, MD 20814		12. REPORT DATE February 1983 13. NUMBER OF PAGES 14
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Bureau of Medicine & Surgery Department of the Navy Washington, D.C. 20372		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Military Personnel Body Composition Military Standards		

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

(U) In response to DOD directive 1308.1, the United States Navy has released a new instruction, OPNAVINST 6110.1B, covering health and physical readiness. This instruction changes the standards for weight control from height/weight tables to a 22% body fat (%BF) standard for men, estimated from neck and abdominal circumferences. In order to determine the possible impact of this change, height, weight, age, neck circumference and abdominal circumference measures were collected on a sample of 986 male U.S. Navy personnel: 174

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